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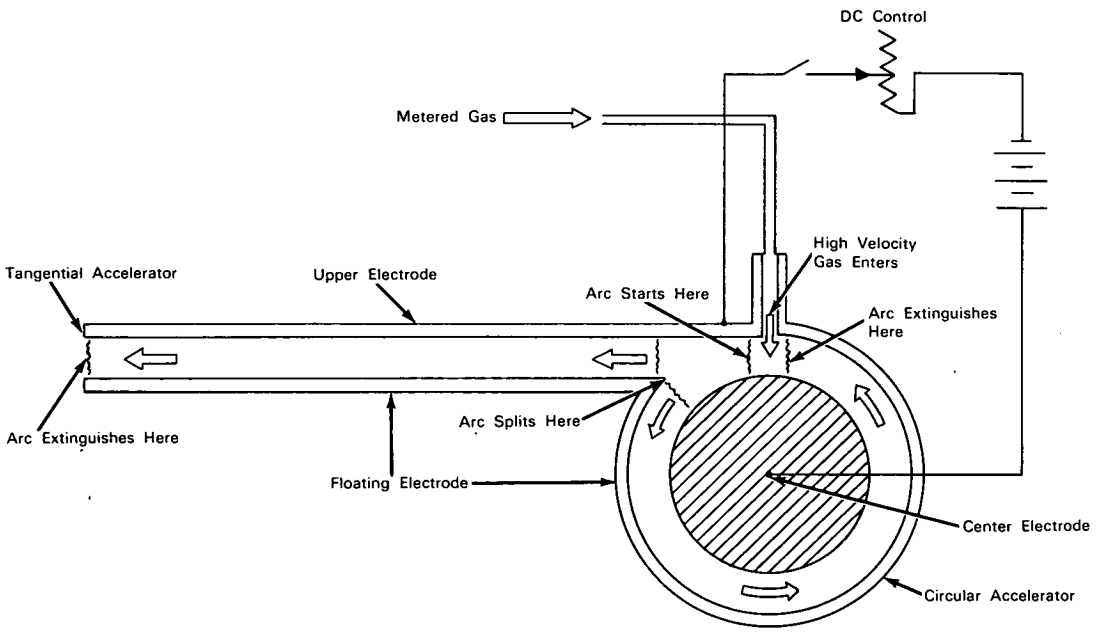
NASA TECH BRIEF

Pulsed Plasma Accelerator Operates Repetitively Without Complex Controls



The problem: Designing a pulsed plasma accelerator that can operate repetitively with a wide variety of gases over a large range of pressures without the use of complex control equipment.

The solution: A dc-powered self-repeating pulsed plasma accelerator that combines a circular channel with a tangential channel at the entrance passage of a high-velocity gas. The walls of the accelerator are electrically conductive and serve as electrodes.

How it's done: The two electrodes formed by the upper section of the tangential accelerator and the center section of the circular accelerator are maintained at different potentials by the dc power supply. The bottom section of the tangential accelerator and the outer circumference of the circular accelerator serve as a floating electrode, which acts as a conductor when the plasma arc splits. The magnetohydrodynamic force is applied to the plasma stream by the dc field between the electrodes and a steady magnetic field (perpendicular to the plane of the paper) maintained within the channels from a separate source (not shown in the schematic diagram). The inside walls of the accelerator electrodes are made of a suitable refractory metal, and the annular spaces between the walls can be used for the circulation of a coolant.

In operation, the test gas is introduced into the system and the arc is started in a conventional manner, such as by placing a jumper between the top

(continued overleaf)

electrode of the tangential accelerator and the center electrode of the circular accelerator and then closing the switch. This action starts the arc which begins to rotate in the direction of the arrows within the circular accelerator. Once the arc begins to circulate, it breaks into two arcs, one arc traveling down the tangential accelerator and the other around the circular accelerator. The two arcs simultaneously reach the ends of both accelerators where they are extinguished. This operation completes one cycle and places an arc in the position for continued automatic high frequency cycling of the accelerator.

Notes:

1. A variety of gases, including air, can be used to generate plasmas in this system; operating pressures and mass flows of the gases are not critical.
2. The spent plasma can be vented directly into the atmosphere, into an evacuated chamber, or into a channel designed to accelerate or decelerate the flow. When the accelerator operates at high pressures, an exit nozzle can be used to vent the gas at high velocity and low temperature.
3. The operational simplicity and negligible erosion of the electrodes recommend this accelerator for experimental aerodynamic and heat-transfer studies in an air atmosphere and as an arc heater.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Langley Research Center
   Langley Station
   Hampton, Virginia, 23365
   Reference: B65-10062

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

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